Seametrics

PT12

Pressure/Temperature Sensor Instructions

Range 0-30 PSIA / 10m / 35ft
Modbus PT12
MADE IN USA C€

For PSIG sensors, refer to page 16 regarding desiccant use!

General Information

Installation

Operation/Modbus RTU

Operation/SDI-12

Maintenance

Troubleshooting

The **Seametrics PT12** Pressure/Temperature Sensor has been designed to provide trouble-free submersible operation in liquid environments. This sensor communicates via SDI-12 (v1.3) or Modbus® RTU (RS485)protocol.

Pressure/level is measured with an extremely rugged and stable piezo-electric, media isolated pressure element and compensated for temperature using Seametrics' proprietary calibration methodology. Temperature is measured using an on-board digital chip.

Seametrics also carries a special version of the PT12 designed to measure barometric pressure in reference to absolute pressure. If you are using an absolute PT12, contact your representative for details on how our PT12-BV can facilitate obtaining barometrically compensated pressure/level.

Dimensions

8.44" (21.4 cm)

0.28" (0.7 cm)

Water inlets

Diameter
0.75" (1.9cm)

Specifications*

Size	Weight	0.8 lb. (0.4 kg)		
	Length	8.44" (21.4 cm)		
	Diameter	0.75" (1.9 cm)		
Wetted Materials	Body Material	316 stainless or titanium, Viton, Acetal		
Cable	Cable	Submersible: polyurethane, polyethylene, or ETFE; 4 lb./100 ft., 1.8 kg/30 m; 2000 ft max for Modbus®		
	Desiccant	1-3 mm indicating silica gel		
	Field Connector	Available as an option		
Temperature	Operating Range	Recommended: -15˚ to 55˚C (5˚ to 131˚F) Requires freeze protection kit if using pressure option in water below freezing.		
	Storage Range	-40˚ to 80˚C (-40˚ to 176˚F)		
Power	Voltage	9-16Vdc, electromagnetic & transient protection IEC-61000 - 4-3, 4-4, 4-5, 4-6		
	Supply Current	Active 3mA average/ 10mA peak; sleep 150 µA		
Communication	Modbus®	RS485 Modbus® RTU, output=32bit IEEE floating point		
	SDI-12	SDI-12 (ver. 1.3) - ASCII		
Output Channels		**Temperature**	**Depth/Level**	
	Element	Digital IC on board	Silicon strain gauge transducer, 316 stainless or Hastelloy	
	Accuracy	±0.5°C — 0° to 55°C (32˚ to 131˚F) ±2.0°C — below 0°C (32˚F)	±0.05% FSO (typical, static) ±0.1% FSO (maximum, static) (B.F.S.L. 20˚C)	
	Resolution	0.06˚C	0.0034% FS (typical)	
	Range	-15˚ to 55˚C (5˚ to 131˚F)	Gauge	PSI: 1[2], 5, 7, 15, 30, 50, 100, 300 FtH$_2$O: 2.3[2], 12, 35, 69, 115, 231, 692 mH$_2$O: 0.7[2], 3.5, 5, 10.5, 21, 35, 70, 210
			Absolute[2]	PSI: 30, 50, 100, 300 FtH$_2$O: 35, 81, 196, 658 mH$_2$O: 10, 24, 59, 200
	Compensated	---	0˚ to 40˚C (32˚ to 104˚F)	
Max operating pressure		1.1 x full scale		
Over pressure protection		3x full scale up to 300psi - for > 300psi (650 ft or 200 m) contact factory		
Burst pressure		1000 psi (approx. 2000 ft or 600 m)		
Environmental		IP68, NEMA 6P		

*Specifications subject to change. Please consult out web site for the most current data (seametrics.com). Modbus is a registered trademark of Schneider Electric.

1 ±0.25% accuracy FSO (max) at this range
2 Depth range for absolute sensors has 14.7 PSI subtracted to give actual depth allowed.

How Pressure Sensors Work

Liquids and gasses do not retain a fixed shape. Both have the ability to flow and are often referred to as fluids. One fundamental law for a fluid is that the fluid exerts an equal pressure in all directions at a given level. Further, this pressure increases with an increasing depth of "submergence". If the density of a fluid remains constant (noncompressible...a generally good assumption for water at "normal" pressures and temperatures), this pressure increases linearly with the depth of "submergence".

We are all "submerged" in the atmosphere. As we increase our elevation, the pressure exerted on our bodies decreases as there is less of this fluid above us. It should be noted that atmospheric pressure at a given level does vary with changes in the weather. One standard atmosphere (pressure at sea level at 20º C) is defined to be 14.7 PSI (pounds per square inch).

There are several methods to reference a pressure measurement. Absolute pressure is measured with respect to an ideal vacuum (no pressure). Gauge pressure is the most common way we express pressure in every day life and is the pressure exerted over and above atmospheric pressure. With this in mind, gauge pressure (Pg) can be expressed as the difference between the absolute pressure (Pa) and atmospheric pressure (Patm):
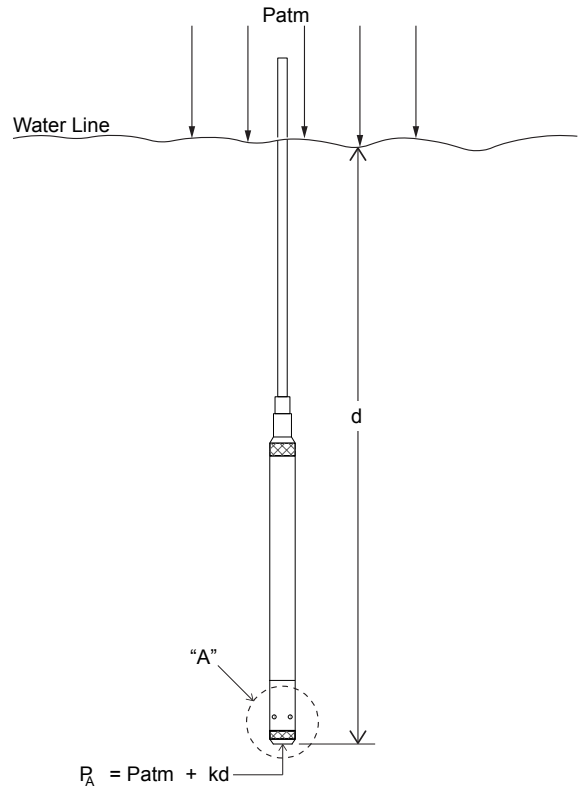
$$Pg = Pa - Patm.$$

To measure gauge pressure, atmospheric pressure is subjected to one side of the system and the pressure to be measured is subjected to the other. The result is that the differential (gauge pressure) is measured. A tire pressure gauge is a common example of this type of device.

Recall that as the level of submergence increases (in a noncompressible fluid), the pressure increases linearly. Also, recall that changes in weather cause the absolute atmospheric pressure to change. In water, the absolute pressure (Pa) at some level of depth (d) is given as follows:

$$Pa = Patm + kd$$

where k is simply a constant
(i.e.: 2.307 feet of water = 1 PSI)

Seametrics' standard gauge submersible pressure devices utilize a vent tube in the cable to allow the device to reference atmospheric pressure. The resulting gauge pressure measurement reflects only the depth of submergence. That is, the net pressure on the diaphragm is due entirely to the depth of submergence.

Pressure Diagram: See Detail A.
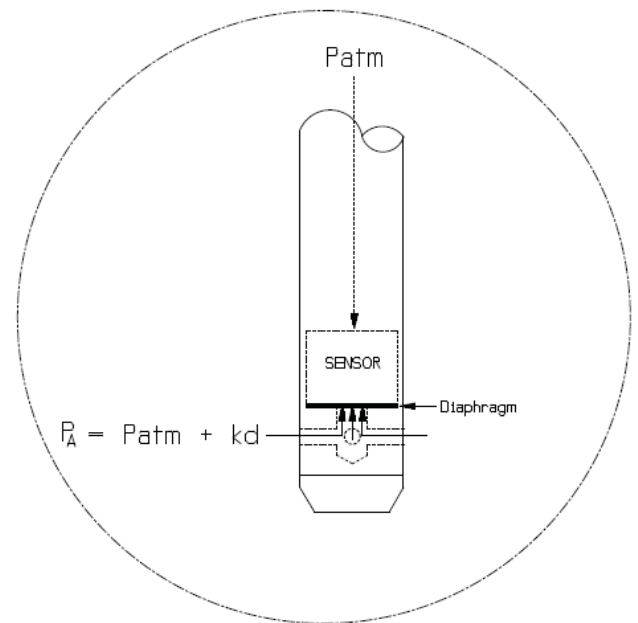
*Absolute pressure is given as Pa = Patm + kd
(where k is 2.307 feet of water)*

Initial Inspection and Handling

Upon receipt of your sensor, inspect the shipping package for damage. If any damage is apparent, note the signs of damage on the appropriate shipping form. After opening the carton, look for concealed damage, such as a cut cable. If concealed damage is found, immediately file a claim with the carrier.

Check the etched label on the sensor to be sure that the proper range and type were provided. Also check the label attached to the cable at the connector end for the proper cable length.

Do's and Don'ts
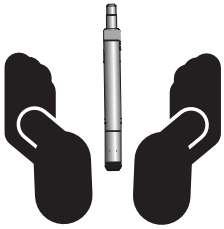
Do handle sensor with care
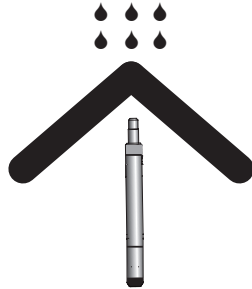
Do store sensor in a dry, inside area when not in use
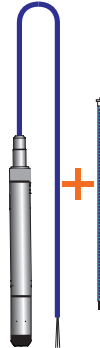
Do install a desiccant tube if using a gauge sensor
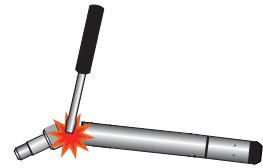
Do not disassemble— will void warranty!
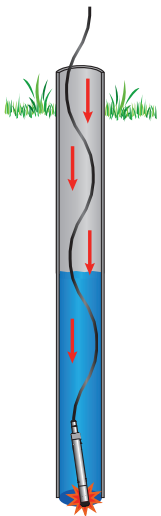
Don't drop into well
Lower gently to prevent damage
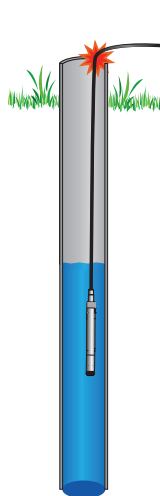
Don't scrape cable over edge of well
May nick or fray the cable
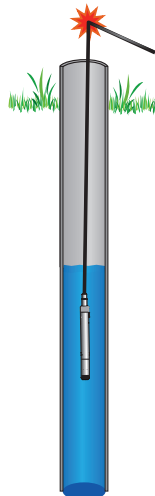
Don't bend cable sharply
May close off vent tube and/or weaken internal wires

Don't support sensor with the connector
Use a strain relief device

Cable Wiring

White	12 VDC+ (Vaux)
Purple	Modbus D- (Not used)
Yellow	Modbus D+ (Not used)
Brown	SDI-12 Signal
Blue	12 VDC- (GND)
Shield	Earth ground

For SDI-12

White	1	12 VDC+ (Vaux)
Purple	2	Modbus D- (Not used)
Yellow	3	Modbus D+ (Not used)
Brown	4	SDI-12 Signal
Blue	5	12 VDC- (GND)
Shield		

5-Pin
Connector

For SDI-12
— with optional 5-pin connector

White	12 VDC+ (Vaux)
Purple	Modbus D-
Yellow	Modbus D+
Brown	SDI-12 Signal (Not used)
Blue	12 VDC- (Gnd)
Shield	Earth ground

For Modbus®

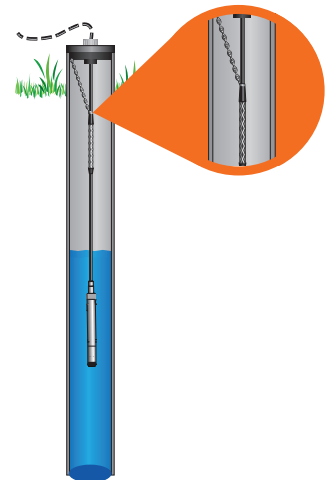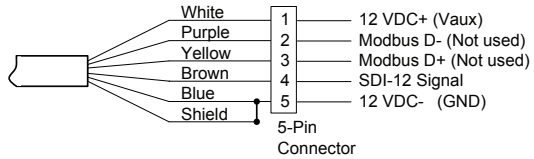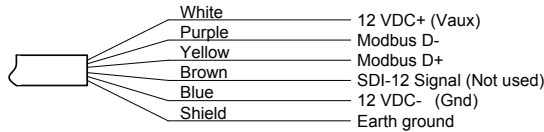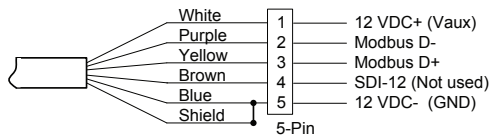|		
White	1	12 VDC+ (Vaux)
Purple	2	Modbus D-
Yellow	3	Modbus D+
Brown	4	SDI-12 (Not used)
Blue	5	12 VDC- (GND)
Shield		

5-Pin

For Modbus®
— with optional 5-pin connector

Installing the Sensor

The PT12 measures pressure. The most common application is measuring liquid levels in wells and tanks.   In order to do this, the sensor must be installed below the water level at a fixed depth.   The installation depth depends on the range of the sensor.   One (1) PSI is equal to approximately 2.31 feet of water.   If you have a 5 PSI sensor, the range is 11.55 feet of water and the sensor should not be installed at a depth below 11.55 feet.   If the sensor is installed below its maximum range, damage may result to the sensor and the output reading will not be correct.

- Lower the sensor to the desired depth.
- Fasten the cable to the well head using a weather proof strain-relief system.   When securing a vented cable, make sure not to pinch the cable too tightly or the vent tube inside the cable jacket may be sealed off.
- Take a measurement to insure the sensor is not installed below its maximum range.

For vented sensors, install the sensor so that the desiccant tube will not flood or lie in water.

The sensor can be installed in any position; however, when it leaves the factory it is tested in the vertical position. Strapping the sensor body with tie wraps or tape will not hurt it.   Seametrics can provide an optional 1/4" NPT input adapter which is interchangeable with the standard end cone for those applications where it is necessary to directly attach the sensor to a pipe, tank, or other pipe port. If the sensor is being installed in a fluid environment other than water, be sure to check the compatibility of the fluid with the wetted parts of the sensor.

Desiccant Use

On vented sensors a desiccant tube prevents moisture in the air from being sucked into the vent tube, which can cause erratic readings and sensor damage.

The desiccant tube is filled with blue silica gel beads. A locking barb and a hydrophobic water filter are attached to the end of the desiccant tube. This filter prolongs the life of the desiccant as much as three times over a desiccant tube without the filter.

Install the sensor so that the desiccant tube and cable connector will not flood or lie in water.

The desiccant is a bright blue color when active and dry. See Maintenance section for care and changing of desiccant.

Grounding Issues

It is commonly known that when using electronic equipment, both personnel and equipment need to be protected from high power spikes that may be caused by lightning, power line surges, or faulty equipment. Without a proper grounding system, a power spike will find the path of least resistance to earth ground—whether that path is through sensitive electronic equipment or the person operating the equipment. In order to ensure safety and prevent equipment damage, a grounding system must be used to provide a low resistance path to ground.

When using several pieces of interconnected equipment, each of which may have its own ground, problems with noise, signal interference, and erroneous readings may be noted. This is caused by a condition known as a *Ground Loop*. Because of natural resistance in the earth between the grounding points, current can flow between the points, creating an unexpected voltage difference and resulting erroneous readings.

The single most important step in minimizing a ground loop is to tie all equipment (sensors, data loggers, external power sources, and any other associated equipment) to a single common grounding point. **Seametrics recommends the following:**

- The sensor cable shield (the wrapped shield inside the cable) be attached to the power ground on the data logger

- The grounding lug be connected via a 12 AWG or larger wire, to a grounding rod driven into the earth.

- If you are using an external power supply to power the data logger that it be tied to the same earth ground.

Sensor/Data Logger Configuration

The PT12 submersible pressure/temperature transducer is designed for use with SDI-12 or Modbus® data loggers.

Every sensor is individually calibrated at the factory, using an environmental test chamber and dead-weight tester. Sensor specific calibration values are stored in the sensor. When taking measurements, the internal microprocessor uses these calibration values to thermally compensate the pressure readings.

In addition to the factory set calibration values, the user can enter a field calibration slope and offset for the pressure and temperature channels. Pressure readings default to psi and temperature readings to degrees Celsius. The user can enter a units conversion slope and offset to change units, if desired. See the operation sections for details on changing these values. The power supply voltage channel always returns values in volts.

This section explains how to read your PT12 via Modbus® RTU. (If you want to read via SDI-12, see the next section beginning on page 11.)

Power Consideration

If your sensor is not powered continuously by an auxiliary power supply, then you must turn power on to the sensor at least two seconds before a reading is to be taken to allow the sensor to warm up.

Communication Settings

The PT12 is configured to communicate with 8 data bits, one stop bit, and no parity. Default baud rate is 19200.

Modbus® Functions

All readings are obtained using Modbus® function 03-Read Holding Registers. Readings are located in two registers each. The data is returned as a 32-bit IEEE floating-point value, high word first, also referred to as big-endian, float inverse, or Float AB CD.

Register Definitions

The physical register addresses on the PT12 start numbering from zero – the first address is 0, the second is 1, etc. On the other hand, Modbus® protocol considers the first logical address to be 1, the second logical address to be 2, etc. For example, to take a pressure reading you have to read the physical address 0.

Some programs and equipment when asked to read address 0 will read that physical address. Others however will read that logical address, which is actually the physical address -1 (which does not exist). With these programs and equipment you must add a one to the address – thus in this example you would request a read at address 1.

Still other programs and equipment require the addition of 40,000 or 400,000 to the address to indicate reading holding registers. These usually also require the addition of one to the physical address. Check with your program and/or equipment documentation to determine what style of register addressing is required.

Like many common Modbus® devices the PT12 returns readings starting at register address 0 (or 1 if using one-based addressing). In addition, for compatibility with other Seametrics Smart Sensor equipment, the PT12 also returns these same readings starting at a register address 62592 (or 62593 if using one-based addressing).

Channel Registers Using Standard Addressing

	Zero-Based	One-Based	+40,001	+400,001
Pressure	0	1	40001	400001
Temperature	2	3	40003	400003
Power Supply Voltage	4	5	40005	400005
Averaged Pressure	6	7	40007	400007
Maximum Pressure	8	9	40009	400009
Minimum Pressure	10	11	40011	400011
Averaged Temperature	12	13	40013	400013

Channel Registers Using High Addressing—to match Seametrics Smart Sensors
(Available with firmware 0.13 and higher)

	Zero-Based	One-Based	+40,001
Pressure	62592	62593	462593
Temperature	62594	62595	462595
Power Supply Voltage	62596	62597	462597
Averaged Pressure	62598	62599	462599
Maximum Pressure	62600	62601	462601
Minimum Pressure	62602	62603	462603
Averaged Temperature	62604	62605	462605

Sensor Configuration/Control

Zero-Based	One-Based	+40,001	Description
300=n	301=n	40301=n	Set **averaging**: This enables sensor for n seconds. Each second, the statistical data registers will be updated to contain new averages, max and min. At the completion of n seconds, the final statistical values will be left in the registers, and the sensor will be put to sleep. n = 0..10,800. If n = 0, the sensor is put to sleep, and the statistical data values are not updated.
400=a	401=a	40401=a	Set **sensor address** = a (Write Only)
500=b	501=b	40501=b	Set **baud rate** = b (Write only) 0=38400, 1=19200 (default), 2=9600, 3=4800, 4=2400, 5=1200
600=w	601=w	40601=w	Set **auto-enable**. Causes sensor to be enabled automatically for w seconds after a read of any parameter data register. W=0 disables auto-enable. (This is normally set to 10 seconds at the factory.) For lowest power usage, set this to zero. For fastest readings while still retaining as much power savings as possible, set slightly longer than your read frequency. See section below for information on how this setting affects your readings.
700=L	701=L	40701=L	Set **serial number**. L= unsigned longword value 0x0000000 .. 0xFFFFFFFF (0 .. 4,294,967,295)
800	801	40801	Read **sensor firmware revision**. Word MSB = Major revision, LSB = minor revision. E.g., 0013 = revision 0.13

Readings and the Auto-Enable Setting

When a reading is requested, four things happen:

- The sensor wakes up.

- The current value in the register is returned.

- The sensor turns on the analog portion, begins sampling, and begins putting the new values in the registers.

- If auto-enable is set to a positive value w, the sensor stays awake for w seconds, sampling and moving values into the registers all the while, and then goes to sleep.

- If auto-enable is set to zero, the sensor immediately goes to sleep after putting the reading in the register.

If your read frequency is less than the auto-enable value, the sensor will stay on continuously, and your readings will always be fresh, with the exception of the very first reading.

If your read frequency is greater than the auto-enable value, the following reading sequence is recommended:

1. Request a reading. This begins the wakeup process on the sensor and returns the value currently in the register, which will be old data. Throw this value away.

2. Wait one second, then take another reading. This reading will have fresh data. Record this reading.

Calibration and Conversion Constants

The data is returned as a 32-bit IEEE floating-point value, high word first, also referred to as big-endian, float inverse, or Float AB CD.

Field calibration values and units conversion values can be set by the user. If set, these values will be applied to the readings before values are returned.

Zero-Based	One-Based	+40,001	Description
200-01	201-02	40201-02	Factory Calibration* - Pressure Scale
202-03	203-04	40203-04	Factory Calibration* - Pressure Linearization 1
204-05	205-06	40205-06	Factory Calibration* - Pressure Linearization 2
206-07	207-08	40207-08	Factory Calibration* - Pressure Slope 0
208-09	209-10	40209-10	Factory Calibration* - Pressure Slope 1
210-11	211-12	40211-12	Factory Calibration* - Pressure Slope 2
212-13	213-14	40213-14	Factory Calibration* - Pressure Offset 0
214-15	215-16	40215-16	Factory Calibration* - Pressure Offset 1
216-17	217-18	40217-18	Factory Calibration* - Pressure Offset 2
218-19	219-20	40219-20	Field Calibration - Pressure Slope
220-21	221-22	40221-22	Field Calibration - Pressure Offset
222-23	223-24	40223-24	Field Calibration - Temperature Slope
224-25	225-26	40225-26	Field Calibration - Temperature Offset
226-27	227-28	40227-28	Factory Calibration* - Temperature Alpha
228-29	229-30	40229-30	Factory Calibration* - Temperature Offset
230-31	231-32	40231-32	Factory Calibration* - Tempearture Slope
232-33	233-34	40233-34	Pressure Units - Conversion Slope
234-35	235-36	40235-36	Pressure Units - Conversion Offset
236-37	237-38	40237-38	Temperature Units - Conversion Slope
238-39	239-40	40239-40	Temperature Units - Conversion Offset

⚠ *** Factory calibration values are set at the factory.**

Writing to Factory Calibration registers will void calibration!

Reading via SDI-12
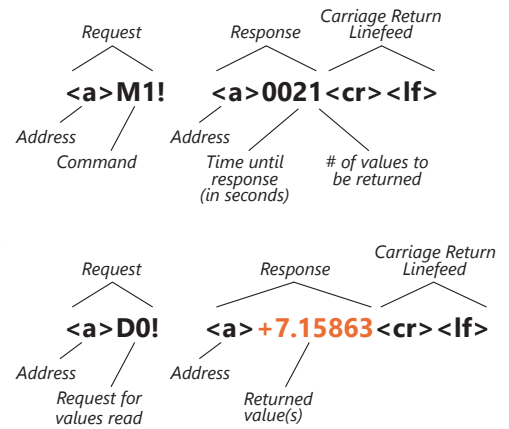
Addressing

Default SDI-12 Address: 0

SDI-12 Command Nomenclature

\<a\> = Sensor address

{crc} = SDI-12 compatible 3-character CRC

\<cr\> = ASCII carriage return character

\<lf\> = ASCII line feed character

highlighted values indicate variable data

All SDI-12 requests consist of a command followed by a request for values. Some software or equipment may combine these, making the second one unnecessary. Refer to your software or equipment documentation for details.

Request   *Response*   *Carriage Return Linefeed*

\<a\>M1!   **\<a\>0021\<cr\>\<lf\>**

Address / *Command*   *Address* / *Time until response (in seconds)* / *# of values to be returned*

Request   *Response*   *Carriage Return Linefeed*

\<a\>D0!   **\<a\>+7.15863\<cr\>\<lf\>**

Address / *Request for values read*   *Address* / *Returned value(s)*

SDI-12 Commands

Sensor Identification

    \<a\>I! \<a\>13 INWUSA PT12 **0.13sssssssss**\<cr\>\<lf\>

Note: **0.13** will change to reflect current firmware version.
sssssssss = device serial number

Acknowledge Active, Address Query

    \<a\>! \<a\>\<cr\>\<lf\>

    ?! \<a\>\<cr\>\<lf\>

Change Address

    \<a\>A\<b\>! \<b\>\<cr\>\<lf\>

Change address to \<b\>

Request Measurement

    \<a\>M! \<a\>0023\<cr\>\<lf\>

Request all basic measurements

    \<a\>D0! \<a\>**+7.15863+25.0000+12.0512**\<cr\>\<lf\>

Read: pressure, temperature, voltage

    \<a\>M1! \<a\>0021\<cr\>\<lf\>

Request pressure measurement only

    \<a\>D0! \<a\>**+7.15863**\<cr\>\<lf\>

Read pressure

    \<a\>M2! \<a\>0021\<cr\>\<lf\>

Request temperature measurement only

    \<a\>D0! \<a\>**+25.0000**\<cr\>\<lf\>

Read temperature

    \<a\>M3! \<a\>0021\<cr\>\<lf\>

Request power supply voltage

    \<a\>D0! \<a\>**+12.0512**\<cr\>\<lf\>

Read power supply voltage

    \<a\>M4! \<a\>0**ttt**4\<cr\>\<lf\>

Request averaged data. **ttt** depends on programmed average duration.

    \<a\>D0! \<a\>**+7.15863+7.23215+7.051283+25.0000**\<cr\>\<lf\>

Read average pressure, max. pressure, min. pressure, average temperature

M5!, M6!, and M7! only available on PT12-BV/PT12 combination units!

<a>M5! <a>0023<cr><lf>	Request barometrically compensated down-hole pressure, down-hole temperature, surface temperature
<a>D0! <a>**+2.58613+19.2100+21.05122**<cr><lf>	Read: barometrically compensated down-hole pressure, down-hole temperature, surface temperature
<a>M6! <a>0024<cr><lf>	Request non-barometrically compensated down-hole pressure, down-hole temperature, surface pressure, surface temperature
<a>D0! <a>**+17.31813+19.2100+14.732+21.0512**<cr><lf>	Read non-barometrically compensated down-hole pressure, down-hole temperature, surface pressure, surface temperature
<a>M7! <a>**ttt**1<cr><lf>	Request averaged barometrically compensated pressure. **ttt** depends on programmed average.
<a>D0! <a>**+7.12050**<cr><lf>	Read temperature averaged barometrically compensated pressure

Request Measurement with CRC

<a>MC! <a>0023<cr><lf>	Request all basic measurements
<a>D0! <a>**+7.15863+25.0000+12.0512**{**crc**}<cr><lf>	Read: pressure, temperature, voltage
<a>MC1! <a>0021<cr><lf>	Request pressure measurement only
<a>D0! <a>**+7.15863**{**crc**}<cr><lf>	Read pressure
<a>MC2! <a>0021<cr><lf>	Request temperature measurement only
<a>D0! <a>**+25.0000**{**crc**}<cr><lf>	Read temperature
<a>MC3! <a>0021<cr><lf>	Request power supply voltage
<a>D0! <a>**+12.0512**{**crc**}<cr><lf>	Read power supply voltage
<a>MC4! <a>0**ttt**4<cr><lf>	Request averaged data. **ttt** depends on programmed average duration.
<a>D0! <a>**+7.15863+7.23215+7.051283+25.0000**{**crc**}<cr><lf>	Read average pressure, max. pressure, min. pressure, average temperature

MC5!, MC6!, and MC7! only available on PT12-BV/PT12 combination units!

<a>MC5! <a>0023<cr><lf>	Request barometrically compensated down-hole pressure, down-hole temperature, surface temperature
<a>D0! <a>**+2.58613+19.2100+21.05122**{**crc**}<cr><lf>	Read: barometrically compensated down-hole pressure, down-hole temperature, surface temperature
<a>MC6! <a>0024<cr><lf>	Request non-barometrically compensated down-hole pressure, down-hole temperature, surface pressure, surface temperature
<a>D0! <a>**+17.31813+19.2100+14.732+21.0512**{**crc**}<cr><lf>	Read non-barometrically compensated down-hole pressure, down-hole temperature, surface pressure, surface temperature

<a>MC7! <a>**ttt**1<cr><lf>

Request averaged barometrically compensated pressure. **ttt** depends on programmed average.

<a>D0! <a>**+7.12050**{**crc**}<cr><lf>

Read temperature averaged barometrically compensated pressure

Concurrent Measurement

<a>C! <a>0023<cr><lf>

Request all basic measurements

<a>D0! <a>**+7.15863+25.0000+12.0512**<cr><lf>

Read: pressure, temperature, voltage

<a>C1! <a>0021<cr><lf>

Request pressure measurement only

<a>D0! <a>**+7.15863**<cr><lf>

Read pressure

<a>C2! <a>0021<cr><lf>

Request temperature measurement only

<a>D0! <a>**+25.0000**<cr><lf>

Read temperature

<a>C3! <a>0021<cr><lf>

Request power supply voltage

<a>D0! <a>**+12.0512**<cr><lf>

Read power supply voltage

<a>C4! <a>0**ttt**4<cr><lf>

Request averaged data. **ttt** depends on programmed average duration.

<a>D0! <a>**+7.15863+7.23215+7.051283+25.0000**<cr><lf>

Read average pressure, max. pressure, min. pressure, average temperature

C5!, C6!, and C7! only available on PT12-BV/PT12 combination units!

<a>C5! <a>0023<cr><lf>

Request barometrically compensated down-hole pressure, down-hole temperature, surface temperature

<a>D0! <a>**+2.58613+19.2100+21.05122**<cr><lf>

Read: barometrically compensated down-hole pressure, down-hole temperature, surface temperature

<a>C6! <a>0024<cr><lf>

Request non-barometrically compensated down-hole pressure, down-hole temperature, surface pressure, surface temperature

<a>D0! <a>**+17.31813+19.2100+14.732+21.0512**<cr><lf>

Read non-barometrically compensated down-hole pressure, down-hole temperature, surface pressure, surface temperature

<a>C7! <a>**ttt**1<cr><lf>

Request averaged barometrically compensated pressure. **ttt** depends on programmed average.

<a>D0! <a>**+7.12050**<cr><lf>

Read temperature averaged barometrically compensated pressure

Concurrent Measurement with CRC

`<a>CC! <a>0023<cr><lf>`	Request all basic measurements
`<a>D0! <a>+7.15863+25.0000+12.0512{crc}<cr><lf>`	Read: pressure, temperature, voltage
`<a>CC1! <a>0021<cr><lf>`	Request pressure measurement only
`<a>D0! <a>+7.15863{crc}<cr><lf>`	Read pressure
`<a>CC2! <a>0021<cr><lf>`	Request temperature measurement only
`<a>D0! <a>+25.0000{crc}<cr><lf>`	Read temperature
`<a>CC3! <a>0021<cr><lf>`	Request power supply voltage
`<a>D0! <a>+12.0512{crc}<cr><lf>`	Read power supply voltage
`<a>CC4! <a>0ttt4<cr><lf>`	Request averaged data. **ttt** depends on programmed average duration.
`<a>D0! <a>+7.15863+7.23215+7.051283+25.0000{crc}<cr><lf>`	Read average pressure, max. pressure, min. pressure, average temperature

CC5!, CC6!, and CC7! only available on PT12-BV/PT12 combination units!

`<a>CC5! <a>0023<cr><lf>`	Request barometrically compensated down-hole pressure, down-hole temperature, surface temperature
`<a>D0! <a>+2.58613+19.2100+21.05122{crc}<cr><lf>`	Read: barometrically compensated down-hole pressure, down-hole temperature, surface temperature
`<a>CC6! <a>0024<cr><lf>`	Request non-barometrically compensated down-hole pressure, down-hole temperature, surface pressure, surface temperature
`<a>D0! <a>+17.31813+19.2100+14.732+21.0512{crc}<cr><lf>`	Read non-barometrically compensated down-hole pressure, down-hole temperature, surface pressure, surface temperature
`<a>CC7! <a>ttt1<cr><lf>`	Request averaged barometrically compensated pressure. **ttt** depends on programmed average.
`<a>D0! <a>+7.12050{crc}<cr><lf>`	Read temperature averaged barometrically compensated pressure

Extended Commands

Set duration for averaging reading

`<a>XAttt! <a>ttt<cr><lf>`	Set duration of averaged data for M4, MC4, C4, and CC4 commands. **ttt** = 1–997 seconds

Read/Modify Calibration Values

`<a>XCnn{=<value>}! <a><value><cr><lf>`	Read {modify} calibration **value nn**

Examples:

`<a>XC00! <a>+1.591600e-5<cr><lf>`	Read the value from calibration register 00
`<a>XC00=1.704e-4! <a>+1.704000e-4<cr><lf>`	Set the value of calibration register 00

Set number of significant digits

`<a>XSt! <a>t<cr><lf>`	Set number of significant digits for SDI-12 report data. **t** = 1–7

Calibration Register Definitions

Field calibration values can be set by user. If set, these values will be applied to readings before values are returned. All calibration registers contain floating point values.

SDI-12 Reg. ID	Mnemonic	Description	Default value
00	Scale	Units scale *(counts * Scale = base units, default psi)*	1.591600e-5
01	a	Factory calibration linearized correction factor 1*	0.000000e+00
02	b	Factory calibration linearized correction factor 2*	1.000000e+00
03	m0	Factory calibration slope coeffient 0*	1.000000e+00
04	m1	Factory calibration slope coeffient 1*	0.000000e+00
05	m2	Factory calibration slope coeffient 2*	0.000000e+00
06	b0	Factory calibration offset coeffient 0*	0.000000e+00
07	b1	Factory calibration offset coeffient 1*	0.000000e+00
08	b2	Factory calibration offset coeffient 2*	0.000000e+00
09	mField	Field pressure calibration slope	1.000000e+00
10	bField	Field pressure calibration offset	0.000000e+00
11	mT	Field temperature calibration slope	1.000000e+00
12	bT	Field temperature calibration offset	0.000000e+00
13	T_Alpha	Factory temperature calibration–Alpha*	0.000000e+00
14	T_Offset	Factory temperature calibration–Offset*	0.000000e+00
15	T-ZeroSlope	Factory temperature calibration–ZeroSlope*	0.000000e+00
16	P_mUnits	Pressure units conversion slope	1.000000e+00
17	P_bUnits	Pressure units conversion offset	0.000000e+00
18	T_mUnits	Temperature units conversion slope	1.000000e+00
19	T_bUnits	Temperature units conversion offset	0.000000e+00

> ⚠ *** Factory calibration values are set at the factory.**
> **Writing to Factory Calibration**
> **registers will void calibration!**

Removing Debris from End Cone

At times mud, silt, or other debris may foul the water inlets to the pressure element. The end cone can be removed to clean out the debris.

Twist Open Housing

1. Gently twist off end cone portion only - do not twist off pressure element!

2. Remove debris. **Do not poke anything into the sensor**. This can damage the sensor element and void the warranty.

3. Replace and retighten the end cone.

— Pressure element

— Water inlet
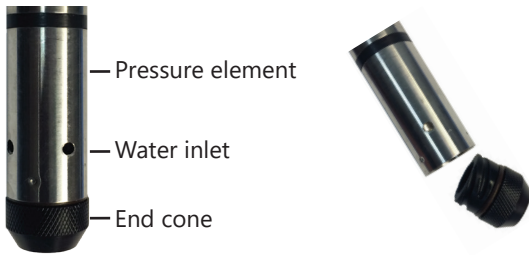
— End cone

Gently twist off the end cone and carefully remove debris

Set Screw Housing

1. Remove the two set screws at the bottom of the housing tube, using a 1/16" allen wrench.

2. Gently remove the end cone.

3. Remove debris. **Do not poke anything into the sensor.** This can damage the sensor element and void the warranty.

4. Replace the end cone and secure with set screws.

Pressure element

Water inlet
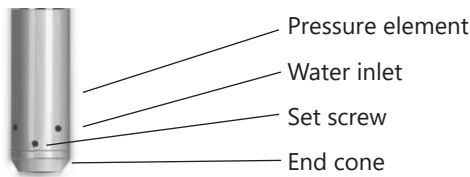
Set screw

End cone

Remove end cone by removing set screws. Gently clean out debris.

Desiccant Tubes

On vented sensors, inspect the desiccant tube at least once every two months. The desiccant tube prevents moisture in the air from being sucked into the vent tube, which can cause erratic readings and sensor damage.

The desiccant tube is filled with blue silica gel beads. A locking barb and a hydrophobic water filter are attached to the end of the desiccant tube. This filter prolongs the life of the desiccant as much as three times over a desiccant tube without the filter.

Install the sensor so that the desiccant tube and cable connector will not flood or lie in water.

The desiccant is a bright blue color when active and dry. As moisture is absorbed the color will begin to fade, becoming a light pink, which indicates full saturation and time to replace. Replacement desiccant and hydrophobic filters can be purchased from Seametrics.

To Change the Desiccant:

- Pulling gently remove the black tube fitting from the clear desiccant tube.

- Using needle-nose pliers, remove the dark gray foam plug. Do not discard the plug.

- Dump out the old desiccant beads and refill with new desiccant beads – tapping desiccant tube frequently during refilling to ensure that the beads are fully seated in tube.

- Push the foam plug back into the tube.

- Reinsert the black fitting.

Desiccant Tube

Black Tube Fitting

Desiccant Tube   Foam Plug

Black Tube Fitting
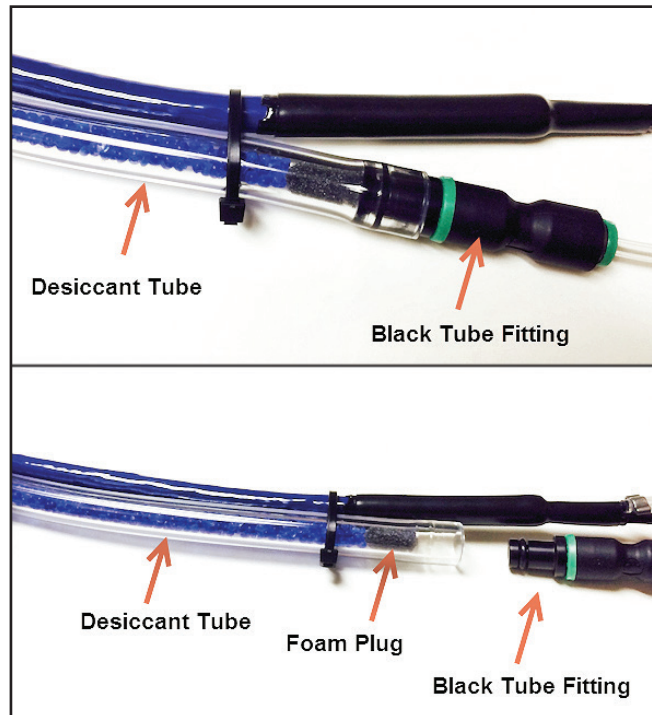
Sensor

There are no user-serviceable parts. If problems develop with sensor stability or accuracy, contact Seametrics. If the transducers have been exposed to hazardous materials, do not return them without notification and authorization.

Cable

Cable can be damaged by abrasion, sharp objects, twisting, crimping, crushing, or pulling. Take care during installation and use to avoid cable damage. If a section of cable is damaged, it is recommended that you send your sensor back to replace the cable harness assembly.

End Connections–if using optional field connector

The contact areas (pins & sockets) of the connectors will wear out with extensive use. If your application requires repeated connections other types of connectors can be provided. The connectors used by Seametrics are not submersible, but are designed to be splash-resistant.

Problem	Probable Causes	Things to try...
Erratic readings	Poor connection due to moisture between contacts in connector	Dry thoroughly. Be sure desiccant is fresh (see Maintenance section).
	Loose or broken wires in connector	Repair or return for evaluation and repair
	Damaged cable, cracked or fraying	Replace cable
	Moisture in the unit	Return for evaluation and repair
	Damaged transmitter	Return for evaluation and repair
Oscillating readings over time (usually 0.5 to 1.5 feet of water)	Plugged vent tube (if using a vented unit)	Be sure desiccant tube is installed. Test by gently applying a small amount of pressure to the end of the desiccant tube and seeing if this affect the transmitter reading. If it does not, then the vent tube is plugged. Return for evaluation and repair.
	Actual water level changes in the aquifer itself in response to barometric pressure changes. This effect can occur in tight formations where the transmitter will immediately pick up barometric changes but the the aquifer will not.	You will need to record barometric pressure as well as the water level pressure and compensate the data
Zero readings when pressurized	Poor connection due to moisture between contacts in connector	Dry thoroughly. Be sure desiccant is fresh (see Maintenance section).
	Loose or broken wires in connector	Repair or return for evaluation and repair
	Damaged cable, broken, cracked, or fraying	Replace cable
	No apparent damage upon visual inspection	Return for evaluation and repair

LIMITED WARRANTY/DISCLAIMER - PT12
SUBMERSIBLE PRESSURE TRANSDUCER

A.   Seller warrants that products manufactured by Seller when properly installed, used and maintained with a properly installed desiccant tube, shall be free from defects in material and workmanship.   Seller's obligation under this warranty shall be limited to replacing or repairing the part or parts or, at Seller's option, the products which prove defective in material or workmanship within TWO (2) year from the date of delivery, provided that Buyer gives Seller prompt notice of any defect or failure and satisfactory proof thereof.   Any defective part or parts must be returned to Seller's factory or to an authorized service center for inspection.   Buyer will prepay all freight charges to return any products to Seller's factory, or any other repair facility designated by Seller.   Seller will deliver replacements for defective products to Buyer (ground freight prepaid) to the destination provided in the original order.   Products returned to Seller for which Seller provides replacement under this warranty shall become the property of Seller.

This limited warranty does not apply to lack of performance caused by abrasive materials, corrosion due to aggressive fluids, mishandling or misapplication.   Seller's obligations under this warranty shall not apply to any product which (a) is normally consumed in operation, or (b) has a normal life inherently shorter than the warranty period stated herein.

In the event that equipment is altered or repaired by the Buyer without prior written approval by the Seller, all warranties are void.   Equipment and accessories not manufactured by the Seller are warranted only to the extent of and by the original manufacturer's warranty.

THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, WHETHER ORAL, WRITTEN, EXPRESSED, IMPLIED OR STATUTORY.   IMPLIED WARRANTIES OF FITNESS AND MERCHANTABILITY SHALL NOT APPLY.   SELLER'S WARRANTY OBLIGATIONS AND BUYER'S REMEDIES THEREUNDER (EXCEPT AS TO TITLE) ARE SOLELY AND EXCLUSIVELY AS STATED HEREIN.   IN NO CASE WILL SELLER BE LIABLE FOR CONSEQUENTIAL DAMAGES, LABOR PERFORMED IN CONNECTION WITH REMOVAL AND REPLACEMENT OF THE SENSOR SYSTEM, LOSS OF PRODUCTION OR ANY OTHER LOSS INCURRED BECAUSE OF INTERRUPTION OF SERVICE.   A NEW WARRANTY PERIOD SHALL NOT BE ESTABLISHED FOR REPAIRED OR REPLACED MATERIAL, PRODUCTS OR SUPPLIES.   SUCH ITEMS SHALL REMAIN UNDER WARRANTY ONLY FOR THE REMAINDER OF THE WARRANTY PERIOD ON THE ORIGINAL MATERIALS, PRODUCTS OR SUPPLIES.

B.   With respect to products purchased by consumers in the United States for personal use, the implied warranties including but not limited to the warranties of merchantability and fitness for a particular purpose, are limited to twenty four (24) months from the date of delivery.

Some states do not allow limitations on the duration of an implied warranty, so the above limitation may not apply to you.   Similarly, some states do not allow the exclusion or limitation of consequential damages, so the above limitation or exclusion may not apply to you.   This limited warranty gives you specific legal rights; however, you may also have other rights which may vary from state to state.